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| **Architecture Design** |
| Human Resource Management Project |
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| This document describes the architecture design for Human Resource Management (HRM) project. In this document, the view, including static view, physical view, and dynamic view will be shown. In addition, the data model will be described in this. |
|  |
| **HRM- Architecture team** |
| **1/14/2012** |
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**Revision History**

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| --- | --- | --- | --- |
| **Date** | **Version** | **Author** | **Description** |
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1. Documentation roadmap

# Scope

This document covers following:

* Client’s vision, project goals, context, and constraints of the system being developed
* Architectural drivers (high level functional requirements, quality attributes, and constraints) and prioritized utility tree
* Architectural views
* Architectural decisions
* Tradeoff analysis

The specification is intended for the following audience:

* Stakeholders for the Human Resource Management(GSD) project
  + - * Team HRM-PIM
* Van Lang’s IT Faculty
  + - * Audience that might want to get an insight into or analyze the architecture and the design of the HRM project

# 1.2 Document organization:

This document includes three important parts:

**Part 1:** How to read this document

**Part 2:** System overview- The summarize of architectural drivers (High level requirement, quality attribute and constraint)

**Part 3:** View

*Physical* – How software and hardware interact with each other.

*Static* – The module of HRM system.

*Dynamic* – The interaction between HRM components.

The structure for presenting the view

**Session 1**: Primary presentation- The figure to present the view

**Session 2**: Element catalog – The table for describing the element which present in figure

**Session 3**: Element behavior- The flow of each component (This part is just for Dynamic perspective)

**Session 4:** Architecture background- Includes design decision and reasons for designing

1. System overview:

# Project Overview

**Project name:** Human Resource Management Program

**Clients:** Human Resource Department- Van Lang University

**Mentors:** Quang Nguyen (Van Lang University)

**Developer team:**

* Nhung Huynh- Team leader
* Tan Tran
* Tuong Nguyen
* Nguyen Dinh
* Dang Nguyen
* Loc Phan
* Quyet Nguyen
* Tung Nguyen

# Project Background

Human Resource Department in Van Lang University gets used to manage personal information in MS Excel. Now they need a new tool that supports only for managing human resource in Van Lang.

The vision of the project is to develop personal information management. In the future, the system will develop other function related to payroll, insurance information…

# **Project Goal**

HRM is particularly developed for human resource management in university colleges. The system consists of key modules:

* Personal information management
* Employee labor contract management
* Recruitment & training processing
* Payroll
* Administration panel – Utilities

1. System Context:

|  |  |
| --- | --- |
| **Actor** | **Description** |
| Educated Department |  |
| Administrator |  |
| Salary Group |  |
| Department |  |
| HR Group |  |
| Account Department |  |

*Figure 2: System Context of HRM project*

1. Architecture drivers:

*See more in Architecture Driver Document*

1. Architecture Style/Patterns & Tactics:

This section discusses the architectural styles and patterns that the HRM architecture possesses. It also provides rationale for selection of these styles.

# Styles/ Pattern

We identify that the style that will be used in HRM- PIM (Personal Information Management) project will be client and server style based on the architecture analyzing. Following is the rationale for choosing client and server as the style for the HRM- PIM project:

* Personal information data needs to be shared with all authorized users. Users can access these data from globally distributed locations and number of users may range from 10 to 50. In order to achieve these requirements and qualities, we decided to have a PIM server that would store and manage data.
* HRM project is web application, all user will access via Web browser with Silverlight runtime is available as a [plug-in](http://en.wikipedia.org/wiki/Plug-in_(computing)) for [web browsers](http://en.wikipedia.org/wiki/Web_browser). The PIM server will provide service based on the requests from client.

**Tiered Architecture:**

In more detail, we decided to use tiered architecture to separate the client, server and database to enhance the security and modifiability. The first tier consists of PIM client. The second tier consists of business services. The third tier provides data management services which using Entity Framework. We will delve into details in later sections.



**Figure 5.1.1 Client and server style for HRM-PIM application**

In this solution, there is a PIM server that responsible for providing the appropriate services that are invoke by the client. The PIM server will also store the data object mapped with Database server and The PIM client will invokes service for manage the personal information such as read and write data in to database, report, import, export data…The user will uses Web browser to access to the PIM Client.

# Tactics used

1. **Modifiability**

*Localization of changes*

We grouped together the components that we anticipated to be affected by the similar kind of changes. E.g. we grouped the view components together; view-model components together… We tried to generalize these modules based on their functions.

*Separation of concern*

Based on the functional requirements, we categorized elements into different sets of components so that the developers can add new components or delete components without affecting the other components.

*Defer binding time.*

The application allows the end user or system administrator to make settings or provide input that affects behavior. E.g. The system administrator can change role permission or assign role in configuration file.

1. **Performance**

*Maintain multiple copies of either data or computations*

We have decided to use caching of data in server level by using Entity Framework. With Entity Framework, we can eliminate the direct data accessing to database which require amount of time for each transaction.

1. **Usability**

**Long running operations**

As most of the operations in the HRM- PIM are going to take time, we are going to design the UI components such that they do not halt when certain long running operations are in progress. We will design asynchronous invocations for such operations by using WCF- RIA services

**Maintain a model of the task**

The model of the task to be performed would be maintained to determine context, such that HRM-PIM system can have an idea of what the user is attempting and can provide assistance. For example, the users would not need to re-enter the same data again, once the data is obtained for the first time, the related information like project name, its components, resources etc, would be pre-populated. This would save time and resources at the users end to perform a task.

**Design time tactics**

Separating user from the rest of the application: we are using Model View View-Model (MVVM) pattern. E.g. UI views form the view, each views will have the corresponding view-models and the models will consists the action in UI controls

1. Architecture Overview:

# Component and connector (C& C) views of HRM- PIM system

# Primary Presentation



**Figure 6.1.1 High level C&C view of the HRM-PIM system**

The figure 5.1.1 depicts the client and server style. PIM client is a client of PIM server and Database Server is system database.

# Element catalog

Following table describes responsibilities of the different element

|  |  |
| --- | --- |
| **Component** | **Responsibility** |
| PIM Server | This component run contains all service components, business objects and data persistence mapped with PIM Database server. PIM server will provide the appropriate services whenever they are invoked by client. These services will be the business service of Personal Information Management and Authentication Service. These service components will be descripted later in Server decomposition.  PIM Server also contains data objects mapped with database in data server. These objects use Entity Framework |
| PIM Client | PIM client runs in Silverlight platform. It invokes the service from PIM server. It can read the data file and update the database on the PIM database server. PIM client also performs authentication of the user. |
| PIM Database Server | This component is SQL Database Server of HRM- PIM system. It contains data that will be used in all system. |
| Web browser | PIM client will be accessed by user via this component. Web browser must be available the Silverlight plug-in. |
| Configuration file | This file contains the Web configuration (host information) for running service. |
| Data files | Data files are the files that need to be imported in Database server. E.g. The import service can only import data in Excel files. |

Following table describes connector used

|  |  |
| --- | --- |
| **Connector** | **Purpose** |
| WebServiceCallReturnConn | This connector represents a web service call made by a caller to a callee. The information is transferred over http(s) connection. |
| FileReadWriteConnT | This connector allows a “user” role to read from or write to a disk file. |
| Server-DatabaseConnT | This connector represents a connection between the server and the database server. In fact, this is the connection between the data object and database by using the ADO.NET Entity Framework |

# C&C Views of PIM Client

# Primary Presentation



**Figure 6.1.2 High level C&C view of the PIM Client**

# Element catalog

Following table describes responsibilities of the different element

|  |  |
| --- | --- |
| **Component** | **Responsibility** |
| Personal Information Manager | This component is responsible for manage the personal information by calling the service. Personal Information includes:   * Data management (add, edit, delete, filter, view… the personal information) * Import management: read the data file and upload into database * Export management: write data into data file with specific format * Report management: create the report based on the inputted information from user |
| Catalog Manager | This component is responsible for manage all catalog that will be used in system. This component allows user edit the system catalog and write to PIM database server by calling the service in PIM Server |
| Login Manager | This component is responsible for validate the user name and password when user inputs them to login. This component will call the authentication service to validation. This component is responsible for login out of system. |
| Client Data | This component acts like a bridge between Personal Information Manager, Catalog Manager, Login Manager components and the PIM server. These components just call Client Data component and this component will calling the service on server instead of call the service by themselves. |
| Profile Manager | This component will be integrated with the Van Lang website to t the staff in VLU can updated their profile information including the information about the articles, science research, thesis guidance, project that the staff take part in. These information will be showed on web site and checked by the web site administrator. |

Following table describes connector used

|  |  |
| --- | --- |
| **Connector** | **Purpose** |
| WebServiceCallReturnConn | This connector represents a web service call made by a caller to a callee. The information is transferred over http(s) connection. |
| FileReadWriteConnT | This connector allows a “user” role to read from or write to a disk file. |
| Server-DatabaseConnT | This connector represents a connection between the server and the database server. In fact, this is the connection between the data object and database by using the ADO.NET Entity Framework |
| CallReturnConnT | Caller calls a certain method of callee and callee performs the requested operation and returns the result back to the caller. |

# C&C views of Personal Information Manager Component

# Primary Presentation



**Figure 6.1.3 C&C view of the Personal Information Manager component**

The fig 6.1.3 depicts the decomposition of component Personal Information Manager. The rationale for this decomposition is to further divide this component into four groups of component by separating the concerns based on high-level functional requirement. It consists some UI views that user interacts with by using web browser. The user can choose to view the personal information (detail and extend information). The authorized users can edit, delete, filter, export and import the personal information data into system. The UI events and properties will be identified and binding in View-Models and the Model will responsible for implement the user action.

# Element catalog

Following table describes responsibilities of the different element

|  |  |
| --- | --- |
| **Component** | **Responsibility** |
| Data Manager Views | This is view components and responsible for displaying screens in PIM client. It consist the user controls for data management of personal information including detail and extend information. These views primarily include the grid for showing the data and the edit screen for update or add new data. |
| Import Manager Views | This is view components and responsible for displaying screens in PIM client. It consist the user controls for import management. These views primarily include the screen with button for user to choose the data files need to import and the grid for showing the imported data that will be upload to database server. |
| Export Manager Views | This is view components and responsible for displaying screens in PIM client. It consist the user controls for export management. User will choose the data grid that needs to be export to Excel file. |
| Report Manager Views | This is view components and responsible for displaying screens in PIM client. It consist the user controls for report management. These views primarily include the field for user to input the information need to report and condition. The report result will be showed on new screen window. |
| Data Manager View-Models | This component is the root component. Each view will has corresponding view-model. Whenever a property on a View-Model object has a new value, it can raise the PropertyChanged event to notify the binding system of the new value. Upon receiving that notification, the binding system will bound properties on Data Manager View. This component responsible for implement the user action and properties from Views. The actions need to implement in data management are:   * Add data * Edit data * Delete data * Refresh data * Sort data * Print data * Save data   This component is also check the permission of user for showing the hide button based the user setting (Check to ensure that the users are allowed to implement the action) |
| Import Manager View-Models | This component is the root component. Each view will has corresponding view-model. This component responsible for implement the user action and properties from Import Manager Views. The primarily actions need to implement in import management are:   * Open file * Import data (Save data)   This component is also check the permission of user for showing the hide button based the user setting (Check to ensure that the users are allowed to implement the action) |
| Export Manager View-Models | This component is the root component. Each view will has corresponding view-model. This component responsible for implement the user action and properties from Export Manager Views. The primarily action need to implement in import management are:   * Export data (Save into file)   This component is also check the permission of user for showing the hide button based the user setting (Check to ensure that the users are allowed to implement the action) |
| Report Manager View-Models | This component is the root component. Each view will has corresponding view-model. This component responsible for implement the user action and properties from Report Manager Views. The primarily action need to implement in import management are:   * Report data   This component is also check the permission of user for showing the hide button based the user setting (Check to ensure that the users are allowed to implement the action) |
| Authentication Model | This model is responsible for loading, checking the permission of user and raising the event to all View-Models to notify and show the hide buttons on views. This component will be call at first when the view is loading. |
| Personal Information Model | The model component has business logic or data validation for implement the action in View-Model. It also responsible for raise the event complete when the action complete. This component is used by four View-Models (Data Manager, Import, Export, Report Manager). |

Following table describes connector used

|  |  |
| --- | --- |
| **Connector** | **Purpose** |
| FileReadWriteConnT | This connector allows a “user” role to read from or write to a disk file. |
| CallReturnConnT | Caller calls a certain method of callee and callee performs the requested operation and returns the result back to the caller. |

# C&C views of Personal Catalog Manager Component

# Primary Presentation



**Figure 6.1.4 C&C view of the Catalog Manager component**

The fig 6.1.4 depicts the decomposition of component Catalog Manager. It consists some UI views that user interacts with by using web browser. The user can choose to view the catalog data. The authorized users can edit, delete, filter catalog data into system. The UI events and properties will be identified and binding in View-Models and the Model will responsible for implement the user action.

# Element catalog

Following table describes responsibilities of the different element

|  |  |
| --- | --- |
| **Component** | **Responsibility** |
| Catalog Data Manager Views | This is view components and responsible for displaying screens in PIM client. It consist the user controls for catalog management. These views primarily include the grid for showing the catalog data and the edit screen for update or add new catalog data |
| Catalog Data Manager View-Models | This component is the root component. Each view will has corresponding view-model. Whenever a property on a View-Model object has a new value, it can raise the PropertyChanged event to notify the binding system of the new value. Upon receiving that notification, the binding system will bound properties on Catalog Manager View. This component responsible for implement the user action and properties from Views. The actions need to implement in catalog management are:   * Add data * Edit data * Delete data * Refresh data * Sort data * Print data * Save data |
| Catalog Model | The model component has business logic for implement the action in View-Model. It also responsible for raise the event complete when the action complete. The common business logic that this component responsible for:   * Delete catalog data * Save catalog data * Get catalog data by key * Get catalog data |

Following table describes connector used

|  |  |
| --- | --- |
| **Connector** | **Purpose** |
| CallReturnConnT | Caller calls a certain method of callee and callee performs the requested operation and returns the result back to the caller. |

# C&C views of Personal PIM Server

# Primary Presentation



**Figure 6.1.5 C&C view of the PIM Server**

The fig 6.1.5 depicts the internals of PIM server. It includes the WCF-RIA services that will be invoked by PIM client. These services will uses the business objects and the business object will call to data objects which uses Entity Framework for design an data model mapped with database server.

# Element catalog

Following table describes responsibilities of the different element

|  |  |
| --- | --- |
| **Component** | **Responsibility** |
| PIM Business Service | This is WCF- RIA service component and hosted on the server. This component provides main services that used in PIM system. It primarily includes Data Manager Service, Export service and Import service. |
| Authentication service | This is WCF- RIA service component and hosted on the server. This component provides services that are invoked by Login Manager in PIM Client. The service is focus mainly on Login and Logout service. |
| Report service | This is WCF- RIA service component and hosted on the server. This component provides services that are invoked by Report Manager. |
| PIM Business Objects | This component contains the attribute of PIM entity with their behavior. E.g. The business object “Employee” with attribute Employee Name, Birthday, Division, Job Title…and the behavior is get and set. |
| PIM Data Objects | This component run in Entity Framework that is the data model mapped which the HRM-PIM Database. The business cannot access directly to database, and have to access through Data Object for reading and writing data. Entity Framework also support the lazy loading. |

Following table describes connector used

|  |  |
| --- | --- |
| **Connector** | **Purpose** |
| WebServiceCallReturnConn | This connector represents a web service call made by a caller to a callee. The information is transferred over http(s) connection. |
| FileReadWriteConnT | This connector allows a “user” role to read from or write to a disk file. |
| Server-DatabaseConnT | This connector represents a connection between the server and the database server. In fact, this is the connection between the data object and database by using the ADO.NET Entity Framework |
| CallReturnConnT | Caller calls a certain method of callee and callee performs the requested operation and returns the result back to the caller. |

# Element behavior

This section depicts the behavior diagram of PIM Data Manager and Import manager to visualize how action of components and how the client and server interact with each other. All the description of component in the following diagram is specified in previous section.

 **Figure 6.1.6 Element behavior of the PIM system- Data management**

 **Figure 6.1.7 Element behavior of the PIM system- Import management**

# Architecture background

# Architecture decision

**Architecture decision #1- AD1**

We have decided to have the server to share the data among the users (N-tier architecture). The number of user can be up to 50 transactions at a time so that have the server will ensure that the user can access to system in everywhere. Especially, with the Manage Profile function, the user can access to system at home to update their profile. We also decide to have a database server separates with the PIM server.

*Trade-off analysis*

**Security:** This decision promotes the attribute security of system because the N-tier separate user with the server and database server so that it will reduce the attack from unauthorized users. The user will not know the location of server and database server.

**Performance:** This decision may inhabit the performance scenario (QAS.02). The PIM client must connect to PIM server and invoke services so that the response time will be increased. It depends on the server computation and the network bandwidth.

**Modifiability:** The N-tier architecture promotes the modifiability because we can add new services in the server without effect the client.

**Architecture decision #2- AD2**

We decide to use MVVM pattern in the client tier. There are three component groups View, View-Model, Model. Each group will have different responsibility.

*Trade-off analysis*

**Modifiability:** MVVMsupport the tactic “Localize the changes” so that it promotes the modifiability. All the components that have the same effect by a change will be grouped together so that developer can modify the system without affect the other components. E.g. The modifying the business logic in Model components will not cause effect in the View component and vice versa

**Performance:** The decision also promotes performance but it not clearly. The View components do not process anything. All processing is happened in View-Model and Model so that response time will be improved.

# Architecture rationale

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Quality** | **Quality ID** | | **Concern** | **Response measure** |
| Performance | QA.01 | | The number of server transactions and database transactions | The number of server transaction is 50 at once.  The response time of server to client is about 2-5 seconds |
| Rationale:   * WCF- RIA server helps improve the performance by editing the configuration file to choose the connection mode and the maximum number of transaction. * Data objects uses entity framework for design the data model mapped with database so that the services do not need to directly access to database so that the performance improved.     Reduce the directly accessing to database  Edit the configuration file to increase the maximum connection | | | |
| Modifiability | QA.05 | Addition of new feature in PIM system  Addition of new service in PIM system | | The modified time is about 5 days with 3 persons |
|  | Rationale:   * The service in server is separate based on their function so that we can easily add new service into system without effect the other service. Such as we will add the payroll service for calculate the employee outcome without affecting the PIM Business service.      * In the PIM client, components have the same effects by a change will be grouped together so that it will be easy to change the platform from Silverlight to WCF (QAS.06). And it will be easy to add new features in client because the component is separated base on their function. E.g. Export components group is the GUI of export function, it different to import is GUI just for importing data.     Change from Silverlight to WCF  Add new GUIs | | | |
| Security | QA.07 | Authentication | |  |
|  | Rationale:   * In PIM client, whenever the view is choose by user, there is the authentication model responsible for checking the permission of that user. Is the user allowed to use this function or not.     Check permission | | | |
| Usability | QA.03 | Easy to learn and use  Long running operation | |  |
|  | Rationale:   * The WCF-RIA service supports the asynchronous invocation so that the operation will not be halt when another operation is in progress. The user can edit personal information while the importing is in progress. * The controls in UI are designed follow by themes, have the tooltip, and Help menu for tutorial. | | | |

# Module views of HRM- PIM system

# Primary Presentation

# 



**Figure 6.1.8 High-level module views of the HRM- PIM system**

The fig 6.1.8 depicts the HRM- PIM system under layer style. There are four layers in system. The first layer is in the PIM Client and the WCF service, Business and Data Access layer are in PIM Server. The description of these layers is in next section.

# Element catalog

Following table describes responsibilities of the different element

|  |  |
| --- | --- |
| **Component** | **Responsibility** |
| Presentation layer | This layer contains modules that used in PIM client. It includes the UI view modules, view-model modules and model modules. This layer run in Silverlight platform |
| WCF Service layer | This layer contains modules that used in PIM server. It includes the service. These services are WCF-RIA services. Services will be used by the modules in presentation layer |
| Business layer | This layer contains modules that used in PIM server. It includes the business object that is used by service layer. |
| Data Access layer | This layer contains modules that used in PIM server. It includes the data object that is used by business layer. This layer uses Entity framework to create the data objects of HRM-PIM System |
| Database | Database that store the data of personal information of PIM system. It is SQL Database server. |

Following table describes relations used

|  |  |
| --- | --- |
| **Connector** | **Purpose** |
| Allow to use | This is the relation between two layers. The upper layer can uses all module on the lower layer but the lower layer can’t |

# Module (C& C) views of HRM- PIM system’s decomposition

# Primary Presentation



**Figure 6.1.9 Module views of presentation layer**

The fig 6.1.9 depicts the decomposition of presentation layer. In this layer contains the View modules, View-Model modules, Model modules to manage the personal information (including data manager, import manager, export manager, report manager), to manage the PIM catalog and login function. All Model modules will uses module “Client data” as a bridge to connect to PIM Server except the “Profile Manager Model” because this function will be integrated in Web site separated with the HRM system. The responsibility of these modules is described in section 6.2, 6.3, 6.4.



**Figure 6.1.10 Module views of Personal Info Manager Views and Catalog Manager Views**

The fig 6.1.10 depicts the views that contains in PIM system. The main view is focus on Personal Info Manager Views and Catalog Views. Beside these views, the PIM system also have Home View and Login View, depend on the user actions, the appropriate views will be displayed

# Element catalog

Following table describes responsibilities of the different element

|  |  |
| --- | --- |
| **Component** | **Responsibility** |
| List Info Views | They are group of views that responsible for displaying the data of personal info. E.g. With function Manage Family Relationship, we will have the GUI is ListFamilyRelationship. These views primarily contain a grid for showing data. |
| Edit Info Views | They are group of views that responsible for add new or edit the data of personal info. E.g. With function Manage Family Relationship, we will have the GUI is EditFamilyRelationshipView. These views primarily contain a text box for inputting the new data and buttons for saving. |
| Upload Views | This is the view for importing the data. It mainly the button for choosing the file that need to be import and the grid for showing the content of data file. |
| Download Views | This is the view for exporting data. |
| Report Views | This is the view for reporting. It primarily include the textbox for inputting the data and condition for reporting and the result will be showed on grid. |
| List Catalog Views | They are group of views that responsible for displaying the data of catalog. E.g. With catalog Job Title, we will have the GUI is ListJobTitle. These views primarily contain a grid for showing data. |
| Edit Catalog Views | They are group of views that responsible for add new or edit the data of catalog. E.g. With catalog City, we will have the GUI is EditCityView. These views primarily contain a text box for inputting the new data and buttons for saving. |
| List Profile View | This is the view that will be showed in the Van Lang website. It mainly includes 4 tabs of profile management   * Project * Article * Science research * Thesis guidance   In each tab will be the grid of data load from database by calling service |
| Edit Profile View | This is the view for editing or adding new profile data. It primarily includes text box for inputting data. |

Following table describes relations used

|  |  |
| --- | --- |
| **Connector** | **Purpose** |
| Uses | This is the relation between two modules. One module can uses the other modules. It may be call- return or request- reply |

# Allocation views of HRM- PIM system

# Primary Presentation



**Figure 6.1.11 Allocation view of HRM- PIM System**

The fig 6.1.11 depicts the allocation view of HRM- PIM system. The PIM system includes the Web server to provide the web services and implement business logic. The Web server will connect to Database server for reading and writing data. HRM Staffs who manage the personal information will connect to Web server in LAN network. The staffs in Van Lang University (VLU Staffs) can connect to system from Internet by using web browser to update their profile data. The system administrator can access to Web server and Database server in LAN network.



**Figure 6.1.12 Deployment view of HRM- PIM System**

This allocation view shows how the HRM- PIM system will be deployed and what are the relationship between different elements and the environment they are running in. As shown in the figure 6.1.12, we will have following elements

|  |  |
| --- | --- |
| **Elements** | **Description** |
| PIM Server Instance | This element is deployed on the Web server run on WCF Framework and Entity Framework |
| PIM Server Database Instance | This element is SQL Database server and is deployed on Database server |
| Web browser | This element must be deployed on all computers to get access to system |
| Profile Manager | This element runs in Silverlight platform. It is deployed on website of Van Lang. This is the only element that could be uses by user from place outside the Van Lang University. This element is separated with other elements. |
| Catalog Manager | These elements belong to PIM Client. They will run on the same PC in Silverlight platform. There could be more than one computer can run “PIM clients”. These elements are not deployed on website, it means that the user cannot use these function at home. |
| Personal Information Manager |
| Login Manager |
| Client Data |

1. Summary: